



To be mathematically proficient, a student must have:

- **Conceptual understanding:** comprehension of mathematical concepts, operations, and relations
- **Procedural fluency:** skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- **Strategic competence:** ability to formulate, represent, and solve mathematical problems
- **Adaptive reasoning:** capacity for logical thought, reflection, explanation, and justification
- **Productive disposition:** habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

National Research Council (2001). Adding It Up: Helping Children Learn Mathematics. Washington, DC: National Academy Press

NAEP (2003). What Does the NAEP Mathematics Assessment Measure? Online at nces.ed.gov/nationsreportcard/mathematics/abilities.asp.

National Council of Teachers of Mathematics (2000). Principles and Standards for School Mathematics. Reston, VA: NCTM

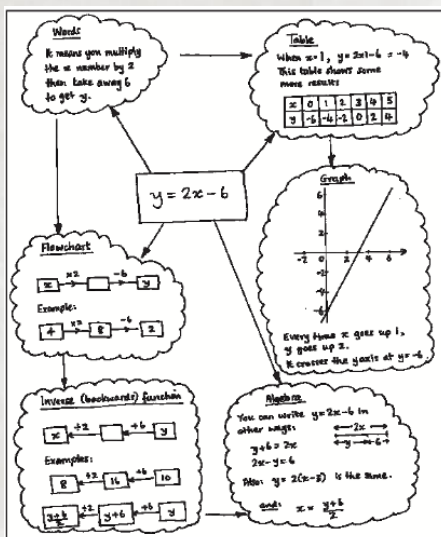
Elements of Effective Math Instruction

Math learning happens best in a robust environment that attends to many needs of the learner. It is more than just learning the concepts, practicing and testing.

The foundation for teaching is the connection we have with each student. Teaching is an extremely personal and is predicated on relationships. Until we establish a connection and build trust, students may not be open to learning. This point has been driven home to me as I now have the opportunity to experience many classrooms. Students are sometimes completely closed to the notion of learning, attempting, and taking risks. Somehow we have to get them to trust us, to understand that we have high expectations for them, we believe in them, they can trust us to help them achieve. We need to explicitly teach students what learning looks like; that learning in mathematics requires taking risks and making mistakes. *If no one made any mistakes no one would learn anything.* Mistakes and misconceptions are welcome in math class! We can focus our dialogue and interactions around learning and improving, helping students realize that learning looks different for everyone in the room, and that in our class, everyone will grow.

Anyone who has played or coached sports knows the importance of having a clear goal in mind for any practice or training. Every lesson in the classroom needs a clear focus that is communicated to students. Knowing exactly what learning needs to take place keeps the teacher on target and focussed, and also is a guide to students. The purpose (goal, target, outcome) of the lesson is the instrument against which we measure all activity in the classroom. We use it to evaluate what lesson activities (videos, opening activities, discussions) are useful, helps focus group work (teaching students explicitly what group learning is for, holding students accountable for meaningful learning, and having students continually self-monitor their collaborative behaviour). The goal of the lesson comes from meaningful planning, knowing our curriculum, deciding what is important, knowing what success looks like and communicating that to students.

We need to help students take ownership of the learning by constructing meaning for themselves through dialogue, rich tasks, writing and multimedia. This means interacting with the content in different ways. For example, learning to graph linear equations is concept then procedure, but can be taught through exploration using graphing software or graphing calculators, having students generate the relationships between slopes and intercepts based on their observations. Later we ask them to communicate their learning to each other and to us through explanations and writing, rather than just performing the procedure. There is abundant research about the importance of having students explain their reasoning, rather than just performing the task.



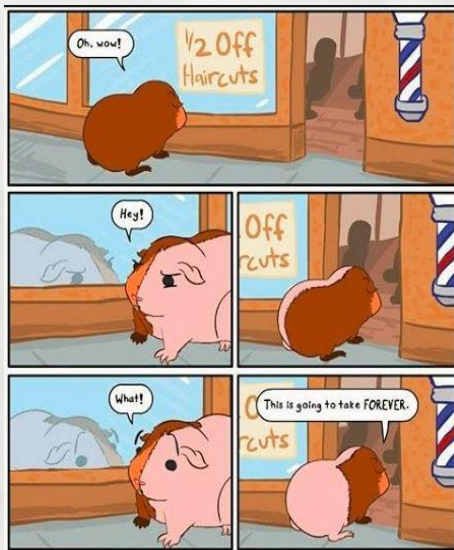
[Standards Unit Improving learning in mathematics: challenges and strategies](http://www.malcolmswan.co.uk/standards-unit-improving-learning-in-mathematics-challenges-and-strategies) [Malcolm Swan University of Nottingham](http://www.malcolmswan.co.uk/)

Most effective instructional practices:

- Student self-assessment/self-grading*
- Response to intervention*
- Teacher credibility*
- Providing formative assessments*
- Classroom discussion*
- Teacher clarity*
- Feedback*
- Reciprocal teaching*
- Teacher-student relationships fostered*
- Spaced vs. mass practice*
- Meta-cognitive strategies taught and used
- Acceleration
- Classroom behavioral techniques
- Vocabulary programs

John Hattie

<http://grantwiggins.wordpress.com/2012/01/07/what-works-in-education-hatties-list-of-the-greatest-effects-and-why-it-matters/>



A neat way to introduce multiplication of fractions, the concept of an "infinite" number of fractions between 0 and 1, or even limits!

Using [multiple representations](#) deepens mathematical understanding. Opportunities to [communicate reasoning](#) help students to understand which representations are efficient and meaningful in a given setting. We are asking our students not only to share strategies but to then understand how to employ the most efficient strategies, both for communicating mathematically and calculating, solving, and proving.

Graphic organizers are proven to be an effective way of helping students construct meaning. There are many types: Mind maps, [frayer](#) models, concept attainment activities, identifying similarities and differences, creating posters and diagrams. They are effective at the beginning of a unit or lesson as review strategies (activating prior knowledge), during learning (for identifying relationships or structuring learning) or as summaries (unit review, making connections between topics). These are just a few ideas!

The three "legs of the stool" of a firm foundation in mathematics are: **Conceptual learning, procedural fluency, and problem solving**. Each of these three is equally important! We still need to [have practice](#) and establish automaticity and efficiency. Practice without conceptual understanding is meaningless if we are trying to create mathematically literate students that can apply and transfer their understanding. Too often we neglect what has always been good learning in the past: direct instruction (which still has a significant effect size, especially for higher level procedural topics), and independent practice. But all things in moderation. A lesson can begin with whole group direct instruction (more in higher grades) and then we can also allow opportunities for collaborative learning and small group instruction, and then use activities such as graphic organizers to revisit the learning and retrieve and construct understanding.

Research from neuroscience supports the importance of writing about learning and using spaced practice as ways to solidify learning. Formative assessment, which helps us plan and respond to learning needs and also helps students understand what they know and what they still need to know, can also help provide opportunities for spaced practice. Everything we teach is assessed. The assessment activities are part of the learning, not isolated events that take time away from teaching and learning. This is why we sometimes say "assessment as learning".

Finally, goal setting and self-monitoring help students achieve self-efficacy, which is a major predictor of success in mathematics. Having students set learning goals for themselves is very motivating, and our [journaling](#) and [formative assessment](#) practices help students gauge their progress toward those goals. The only way for students to set goals and measure their progress is to involve them in [assessment](#). We need to [make assessment criteria](#) very visible to them, even involve them in establishing the criteria. It must be crystal clear what success in our class will look like. A student can hit any target that they can see and that doesn't move (Anne Davies). This means that in every outcome there will be some dialogue and constructing assessment criteria, and having that criteria posted in the room or copied in student notebooks.

[There are so many other things to consider](#): scaffolding, differentiating, enriching, summarizing and notetaking, explicitly teaching study skills, high level questioning, strategies for struggling math learners, vocabulary strategies, to name a few. Please consider following me on twitter and/or google plus where I continually post research, tips, and resources to address all these areas (I rarely duplicate twitter posts on google plus, its usually one or the other). [There is so much available now](#) to teachers and so much expected, the task seems (well let's face it, the task is) overwhelming. But honour what you have always done, evaluate your instruction, attend to expanding your repertoire and collection of resources, explore new methods and ideas, and above all reflect! I wish you a year of growth and new horizons!

BER conference: *Guided Math*

Practical Strategies to
Differentiate your Math
Instruction Using Small
Group Instruction and Math
Learning Centers

Grades 3-6



Regina, November 20

For details, visit

<http://www.ber.org/seminars/CourseInfo.cfm?seid=MUB4F2-REG>

Want to know more about
guided math?

Check out my Livebinder

<http://www.livebinders.com/play/play?id=900044>



Supporting
Student Engagement
in Mathematics

Nov 25 Eamer Auditorium
STF Building Saskatoon

https://www.spdu.ca/workshop/teaching_and_learning.html#supporting_student_engagement_math



Workplace 10/20 Collaborative Day

Where? Fairview Education Centre

When? Oct 24 9:00 till 3:30

What? A chance for teachers to share experiences in Workplace Math Instruction, share year and unit plans and timelines, resources, projects and best practices.

Please register on PD Place. Lunch and mileage is provided

Grades K-8

This fall I am offering a workshop/dialogue around mathematical process standards and **benchmarking**. We can customize the nature of this workshop to fit the needs of teachers, and can engage as a full staff group, PLC, or individual teachers. The goal of the workshop is to help support math instruction through problem solving, through the lens of backward design (considering assessment first). We will examine the benchmarking initiative in GSSD, ideas for teaching through problem solving, and a framework for involving students in assessment. We will discuss mathematical processes, rubrics, assessments, and strategies, and engage in some collaborative assessment of sample problems. By examining problem solving and benchmarking early in the fall, teachers can feel more confident about the process throughout the year.

Math Common Assessments for K-9, now available on GSSD web site

These common assessments were developed in consultation with several school divisions, and have pre and post assessments for every outcome in K through grade 9. To access this folder, follow the link <http://central.gssd.ca/math/> and download the folder.

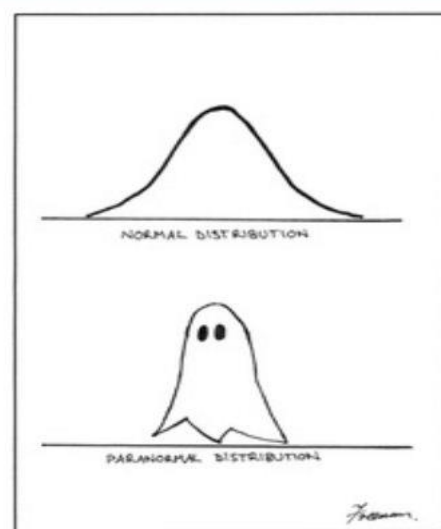
Thinking Skills for the Inquiry
Classroom
SPDU, Feb 6 2014
McDowell Conf Room, STF bldg



Aboriginal Awareness

Preparing to Integrate Aboriginal Content and Perspectives into Teaching and Learning

Nov 6 Eamer Auditorium
STF Building Saskatoon
https://www.spdu.ca/workshops/aboriginal_education.html



Supports for Inquiry and Problem-Based Learning

Did you Know: The Sask School Library Association has supports for inquiry based learning?

<http://ssla.ca/Inquiry>

Problem based learning
Start to Finish:

http://www.edutopia.org/s-tw-project-based-learning-best-practices?utm_source=twitter&utm_medium=post&utm_campaign=STW-PBL-Start-Finish-RSS

I'm learning cool stuff from other math educators as we explore the "Math twitter blogosphere". Classrooms with personality: Have your students create their own "Math Tips and Tricks" wall

<http://pythagoraswasanerd.wordpress.com/2013/10/10/mine-own-classroom/#comment-33>

We know our summative assessments should be more than tests. We need "triangulation of evidence": Products, observations, and conversations. So what are some other ideas?

https://docs.google.com/presentation/d/16JajGwT6JW7WzqS2YXlhjC2HyItLk4efFG68Quj4/pub?start=false&loop=false&delayms=3000#slide=id.gf44d9fde2_0

Cool real-life application to teach pie and bar graphs—and we might learn something too!

<http://www.edutopia.org/blog/what-teacher-do-you-want-philip-mcintosh>

Formative Assessment Feature

Four Corners: This formative assessment stimulates student dialogue and at the same time provides a movement break. Sometimes it may seem that we are creating a disruption or interrupting seat work, but there is a large body of evidence that having movement breaks stimulates learning!

Four corners works best if there is an open ended/opinion questions or a common misconception. For instance, in middle grades we might make a statement "When I multiply a number by another number the result is larger than the original numbers" (because students are just beginning to experience multiplication of decimals and fractions). In highschool we may state that "the inverse of a function is always a function" to see if students can explain the answer.

In the four corners of your room you can put four different answers, four opinions, or statements like "strongly agree, somewhat agree, somewhat disagree, strongly disagree" or any variation that suits your purpose. Have students stand in the corner that represents their opinion. They can first have a conversation with people in their corner to solidify their case, then groups can present their opinion, case to other groups or to whole group. The goal is for students to use appropriate mathematical vocabulary, and construct precise and meaningful argument and proof. Occasionally the teacher may need to guide the conversation to correct reasoning.

We could easily *tell* students a certain rule or relationship, but if they dialogue about it and convince each other, they are using communication to construct meaning for themselves.

Technology for Teaching

Games for learning decimal place:

<http://www.decimalsquares.com/dsGames/>

Math Assessment Resource Service: A very rich site with theory and resources for math assessment, instruction, and links to other sites.

<http://www.toolkitforchange.org/index.php>

Check out NCTM's Illuminations Pins on Pinterest. Lots of visual math demos, virtual manipulative and app tutorials, and more

<http://www.pinterest.com/nctmillum/pins/>

Ten ipad apps for elementary math practice

<http://ipadapps4school.com/2013/10/04/ten-good-ipad-apps-for-elementary-school-math-practice/>

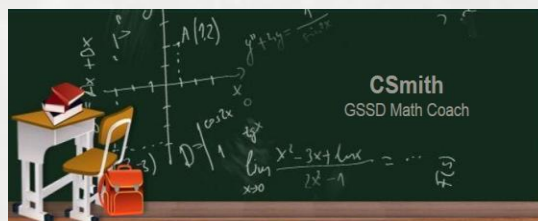
Virtual base 10 blocks <http://classtechtips.com/2013/04/15/virtual-base-10-blocks/>

Create your own ipad games. Give context to math by using photos of your own classroom or community

<http://ipadapps4school.com/2012/12/08/use-tinytap-to-create-your-own-ipad-games/>

Create online quizzes with Quizlet <http://quizlet.com/teachers>

Click the image to go to my blog: Follow me on [Google Plus](#)



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<https://plus.google.com/u/0/112962000833550915075/posts>